AASHTO M 323 – STANDARD SPECIFICATION FOR SUPERPAVE VOLUMETRIC MIX DESIGN

1. Which of the following describes binder requirements?
   a. Must be performance graded meeting the requirements of AASHTO M 320.
   b. Must be appropriate for climate and traffic loading of the project for which it is intended.
   c. Must meet the requirements of SP 1 published by the Asphalt Institute.
   d. All of the above.
   e. None of the above.

2. When RAP (Reclaimed Asphalt Pavement) is used in a Superpave mix design, which of the following best describes what must be done when selecting the virgin binder grade?
   a. Select a binder one grade softer than normal when the RAP percentage is not greater than 15%.
   b. Select a binder one grade stiffer than normal when the RAP percentage is between 15 and 25%.
   c. Select a binder one grade softer than normal when the RAP percentage is greater than 25%.
   d. None of the above.

3. Which of the following are gradation control points or sieves?
   a. Maximum size.
   b. Nominal maximum size.
   c. One sieve smaller than nominal maximum size.
   d. Primary control sieve.
   e. b & c
   f. All of the above.
   g. Who knows?????

AASHTO R 35 – STANDARD PRACTICE FOR SUPERPAVE VOLUMETRIC MIX DESIGN

4. Using the table on the following page, what is the combined percent passing for the No. 4 sieve?
   a. 53
   b. 54
   c. 55
   d. 56
   e. None of the above.

   P = Aa + Bb Cc + . . . Nn

   Where:

   A, B, C …N = Percent passing for individual products (expressed as whole numbers).

   a, b, c, … n = Proportions of individual products used (expressed as decimals).

5. Using the table on the following page, what is the combined G_{sb}(OD) (oven-dry bulk specific gravity) of the blend?
   a. 2.655
   b. 2.657
   c. 2.659
   d. 2.661
   e. None of the above

$$G_{sb}(OD) = \frac{P_1 + P_2 + P_3 + \ldots\ldots\ldots\ldots P_n}{\frac{P_1}{Gsb(OD)_1} + \frac{P_2}{Gsb(OD)_2} + \frac{P_3}{Gsb(OD)_3} + \ldots\ldots\ldots \frac{P_n}{Gsb(OD)_n}}$$

Aggregate Blending Worksheet

Product Identification	Percentage of Products Used (Decimal)				
	Blend No. 1	**a** (1/2")	**b** (3/8")	**c** (1/4")	**d** (Fine)
A (1/2")	**0.23**	0.23			
B (3/8")	**0.22**		0.22		
C (1/4")	**0.17**			0.17	
D (Fine)	**0.38**				0.38
Total	**1.00**				

Grading for 1/2" (12.5 mm) Mix					
Sieve Size	**Comb.**	Individual Product Contributions			
1"	**100**	23	22	17	38
3/4"					
1/2"					
3/8"					
No. 4					
No. 8					
No. 16					
No. 30					
No. 50					
No. 100					
No. 200					

Combined Specific Gravity and Absorption Data					
G_{sb} (OD)					
G_{sb} (SSD)					
G_{sa}					
Absorption					

Additional Design Information for Calculation of P_{bi}	
Binder Specific Gravity G_b	1.022
Log S_n (12.5)	1.0969

Individual Product Identification and Gradations (Percent Passing)				
Sieve Size	**A** (1/2")	**B** (3/8")	**C** (1/4")	**D** (Fine)
1"	100	100	100	100
3/4"	100	100	100	100
1/2"	91	100	100	100
3/8"	12	96	100	100
No. 4	2	20	75	100
No. 8	2	15	21	95
No. 16	2	5	10	78
No. 30	1	2	5	46
No. 50	1	2	3	25
No. 100	1	2	3	18
No. 200	0.3	1.5	2.0	10.3

Individual Aggregate Specific Gravity and Absorption Data				
G_{sb} (OD)	2.802	2.641	2.589	2.610
G_{sb} (SSD)	2.810	2.654	2.626	2.635
G_{sa}	2.826	2.676	2.689	2.677
Absorption	0.30	0.45	0.98	0.90

6. Which of the following is required for calculation of the P_{bi} (initial trial binder content)?
   a. G_{sb}(OD) and G_{sa}
   b. G_{sb}(SSD) and G_{sa}
   c. Estimated G_{se}
   d. a & c
   e. b & c
   f. All of the above.

7. Given the following information, the VMA is _____.
   a. 12.4%
   b. 17.5%
   c. 87.6%
   d. 82.5%
   e. None of the above.

$$VMA = 100 - \left(\frac{G_{mb}\ P_s}{G_{sb}} \right) \qquad V_a = 100 * \left[1 - \left(\frac{G_{mb}}{G_{mm}} \right) \right]$$

where:
$G_{mm} = 2.479$
$G_{mb} = 2.335$
$P_s = 94.3\%$
$G_{sb} = 2.668$

8. Given the above information, the V_a is _____.
   a. 5.8%
   b. 5.9%
   c. 94.2%
   d. 94.3%
   e. None of the above.

9. Given the VMA calculated in question number 7 above, the VMA would be considered appropriate for a 1/2" (12.5mm) Superpave mix design.
   a. True
   b. False

10. During the optimum binder content selection phase of volumetric mix design, five binder contents are used.
    a. True
    b. False

11. Given the following, what is the $\%G_{mm(initial)design}$? Does this meet the Superpave requirements where Design ESALs are 14 million (Yes/No)?
    a. 88.1% - - Yes
    b. 89.9% - - Yes
    c. 88% - - No
    d. 90% - - Yes
    e. None of the above.

$$\%G_{mm\,initial} = 100 * \left(\frac{G_{mb} h_d}{G_{mm} h_i} \right)$$

$$\%G_{mm(initial)design} = \%G_{mm(initial)} - \Delta V_a$$

where:
V_a at nearest lower binder content than that resulting in 4.0% = 5.8%
G_{mm} = 2.502
G_{mb} = 2.467
h_m = 116.8 mm
h_i = 130.7 mm

12. Final selection of optimum design binder content is based on compliance with Table 3 ("Superpave HMA Design Requirements") as shown in the FOP for AASHTO R 35. For design ESALs of 7 million, the following meet the requirement.
    a. True
    b. False

Where:

$\%G_{mm}$ @ N_{inial} :	89.8
$\%G_{mm}$ @ N_{design}:	96.0
% G_{mm} @ N_{max}:	98.9
VFA:	68.1%
$P_{0.075}/P_{be}$:	1.4%

AASHTO R 30 MIXTURE CONDITIONING OF HOT-MIX ASPHALT (HMA)

13. Which of the following statements regarding this FOP is correct?
    a. Mixture conditioning procedures for volumetric design and mechanical property testing are the same except for the period of aging (2 hours vs. 4 hours).
    b. Mixture conditioning according to R 30 simulates long-term aging of the mix.
    c. Conditioning in the laboratory is not necessary prior to volumetric mixture testing of plant-produced HMA.
    d. After mixture conditioning of gyratory compaction samples is completed, it is permissible to allow the sample to cool to room temperature temporarily before reheating to compaction temperature.
    e. All of the above.

14. According to this FOP, which of the following statements is **incorrect**?
    a. Prior to laboratory-mixing samples for volumetric testing it is required to first prepare, mix and discard a butter batch.
    b. Mixture conditioning of samples for volumetric mixture design is conducted at mixing temperature for a period of 2 hours ± 5 minutes.
    c. Mixture conditioning for mechanical property testing is conducted at mixing temperature for a period of 4 hours ± 5 minutes.
    d. When performing mixture conditioning for mechanical property testing it is required to stir the samples every 60 ± 5 minutes.
    e. All of the above.

15. When RAP (Reclaimed Asphalt Pavement) is used in volumetric mix design, it must be added to the aggregate for the period required to heat the aggregate to mixing temperature (usually 2 to 4 hours).
    a. True
    b. False

AASHTO T 312 – METHOD FOR PREPARING AND DETERMINING THE DENSITY OF HOT MIX ASPHALT (HMA) BY MEANS OF THE SUPERPAVE GYRATORY COMPACTOR

16. The angle of gyration may refer to either the internal or external angle. The pressure applied during compaction must be within a specified range. The correct internal angle is _____; that of the external angle is _____; the pressure applied during compaction is _____.
    a. 1.25±0.02º - - 1.16±0.02º - - 600±18 Pa.
    b. 1.16±0.02º - - 1.16±0.02º - - 600±16 kPa.
    c. 1.16±0.02º - - 1.25±0.02º - - 600±18 Pa.
    d. 1.16±0.02º - - 1.25±0.02º - - 600±16 kPa.
    e. None of the above.

17. This FOP covers preparing gyratory-compacted specimens that may be used for field control of HMA production processes.
    a. True
    b. False

18. After filling the mold, leveling the HMA and installing the paper disc, what next must be done?

_____

_____

_____

_____

AASHTO T 283 – RESISTANCE OF COMPACTED BITUMINOUS MIXTURES TO MOISTURE INDUCED DAMAGE

19. Test specimens for T 283 must be compacted to what air void content?
    a. Between 5 and 7 percent.
    b. Between 6 and 8 percent.
    c. Between 6 and 7 percent.
    d. Between 6.5 and 7.5 percent.
    e. None of the above.

20. After saturation it is discovered that the degree of saturation is 65%. What must be done? If the degree of saturation is 81%, what must be done?
    a. For saturation of 65% it is permissible to repeat the saturation process using more vacuum and/or time. For saturation of 81% it is permissible to dry the specimen sufficiently to bring the saturation to within the acceptable 70 to 80% range provided that drying is performed at a temperature of 125 ± 5ºF or lower.
    b. In both cases, the specimen(s) must be discarded because it is never permissible to make further adjustment to specimens outside the range of acceptable saturation.
    c. For saturation of 65% it is permissible to repeat the saturation process using more vacuum and/or time. For saturation of 81% the specimen is damaged and be discarded.
    d. None of the above.

21. Given the following, calculate the TSR. Does TSR meet Superpave requirements?

$$TSR = \frac{S_2}{S_1}$$

where:
S1 = unconditioned subset - 133 psi indirect tensile strength
S2 = conditioned subset – 97 psi indirect tensile strength

AASHTO T 324 – HAMBURG WHEEL-TRACK TESTING OF COMPACTED HOT-MIX ASPHALT (HMA)

22. According to this FOP, test specimens for T 283 must be compacted to what air void content?
    a. Between 5 and 7 percent.
    b. Between 6 and 8 percent.
    c. Between 6 and 7 percent.
    d. Between 6.5 and 7.5 percent.
    e. None of the above.

23. Which of the following specimen sizes are appropriate for testing according to this FOP?
    a. Laboratory-compacted slab specimens of 12.5 inch length and 10.25 inch width having thickness of 1.5 inch to 4 inch.
    b. Superpave gyratory compactor specimens having thickness (height) of 1.5 inch to 4 inch.
    c. Wet-cut compacted specimens from HMA pavements. Slabs shall be of approximately 12.5 inch length and 10.25 inch width and thickness of 1.5 inch to 4 inch. Cores shall be 10 inch diameter.
    d. All of the above.

24. Describe how the SIP (stripping inflection point) is determined by using the creep slope and stripping slope.